

REMARKS

The paragraphs beginning at p. 25, line 19, and p. 26, line 12, have been amended to overcome the drawing objections at paragraph 2 of the Office Action. Claims 1, 3, 6, and 9-16 are allowed. Allowable claims 29 and 31 have been cancelled and rewritten into independent form as new claims 34 and 35, respectively. Thus, claims 34 and 35 are in condition for allowance. Claims 21, 28, and 30 have been amended, and new claims 36-41 have been added, as described below. Claims 1, 3, 6, 9-16, 21-28, 30, 32, and 33-41 are pending in the application. Reconsideration and withdrawal of the remaining rejections are requested in view of the following amendments and remarks. The specification has been amended at page 1 to claim priority to U.S. Patent No. 6,432,214. In view of the pre-November 30, 2000 filing date of this Application, no petition is needed under 37 CFR Rule 1.78(a)(2)(B).

The claims describe a system and method for cleaning semiconductor wafer boxes (and/or doors). The cleaning system includes at least one angle spray nozzle, and may also include straight spray nozzles, and a rotor having box holding positions for holding and rotating the boxes during cleaning. In a preferred embodiment, the straight spray nozzles spray fluid toward the center or spin axis of the rotor. The angle spray nozzles spray fluid at an angle relative to that of the straight spray nozzles to clean interior surfaces and corners of the boxes, as well as exterior surfaces of the boxes and the rotor itself. By using angle spray nozzles, improved cleaning of wafer boxes is achieved, since hard-to-reach areas on the boxes are better targeted by cleaning spray than in prior art systems, which use only straight spray nozzles.

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Claim 21 has been amended to include the limitation that one or more angle spray nozzles are directed to spray fluid toward at least one of a leading interior side surface and a trailing interior side surface of a box on the spinning rotor (see application, p. 26, lines 7-11; p. 27, lines 1-3; Fig. 16). Claim 28 has been amended to include the limitation that the spray means includes an angle spray nozzle directed to spray fluid toward or away from a direction of rotation of the rotor (see application, p. 21, lines 17-20). Claim 30 has been amended to include the limitation that an angle spray nozzle is directed to spray fluid toward an up or down facing surface of a box held on the rotor (see application, p. 27, lines 6-8).

New claim 41 is similar to allowed claim 15.

New claim 36 recites a rotor including a plurality of door holder assemblies for holding doors, wherein at least one of the spray nozzles is an angle spray nozzle (see application, p. 16, lines 2-6). New claim 37 recites that an angle spray nozzle is directed to spray fluid toward an upper section or a lower section of the rotor, or both. (See application, p. 22, line 20 – p. 23, line 12).

New dependent claim 38 recites that at least one of the spray nozzles also sprays in a direction toward or away from the spin direction of rotor. New dependent claim 39 recites that an angle spray nozzle is directed to spray fluid toward an interior corner of a box held on the rotor (see application, p. 21, line 24 – p. 22, line 3; Fig. 16). New dependent claim 40 recites that at least one of the angle spray nozzles is directed to spray fluid toward the leading interior side surface of the box, and at least one of the angle spray nozzles is directed to spray fluid toward the trailing interior side surface of the box (see application, p. 26, lines 7-11; p. 27, lines 1-3; Fig. 16).

Turning to the § 103 rejections at paragraphs 6-10 of the Office Action, while Shortes et al. states that its semiconductor wafer cleaning technique may be used to clean the surface of "any" article, Shortes clearly does not contemplate or suggest that its technique could be used to clean boxes used to hold wafers. First, a system for cleaning boxes is unrelated to a system for cleaning semiconductor wafers, which is a much more precise and delicate process. Boxes are large cube-like objects having internal and external corners and other features. Wafers are typically much smaller and more delicate, flat and thin, with no such (macroscopic) features. Wafers are easily damaged or contaminated. Boxes are not. In Shortes (and similar wafer spin processing prior art, such as Manos 5,672,212), the wafers are centered on the spin axis. In box cleaners, the boxes are spaced radially outwardly from the spin axis (see amended claim 32). Thus, techniques in the prior art for cleaning wafers do not translate directly to cleaning boxes.

The apparatus in Shortes holds semiconductor wafers flat against a planar surface 26 of a rotatable pedestal 25 via suction provided by a vacuum source (col. 4, line 67-col. 5, line 6). This design is not able to hold a cube-like structure, such as a box. The Shortes does not include a rotor, or any other component, that could adequately hold boxes during rotation of the pedestal 25 (Fig. 4). Furthermore, there is very limited space (approximately one inch...col. 7, line 46) between the nozzles 31, 32, 33 and the pedestal 25 in Shortes. These factors suggest Shortes teaches away from the claims.

The rationale for using angled nozzles in the Shortes apparatus is unrelated to the claimed invention. The claimed angle spray nozzles were conceived as an

improvement over prior art box cleaning systems that use only straight spray nozzles (see application, p. 20, lines 3-9), such as Bryer et al. Angle spray nozzles can direct spray into corners, grooves, slots, leading and trailing interior and exterior surfaces, and other hard-to-reach areas of the boxes that may not be sufficiently exposed to cleaning fluid when only straight spray nozzles are used. The claimed angle spray nozzles provide improved cleaning of the boxes.

There is no suggestion in Shortes to use angled nozzles to spray hard-to-reach areas of a wafer, a box, or anything else. Rather, the nozzles 31, 32, 33 in Shortes are angled simply because of their positioning relative to the pedestal 25 and the wafer to be treated (see Fig. 4). In fact, the nozzles 31, 32, 33 in Shortes are angled to deliver a flat fan-like spray pattern to the wafer surface along a substantially linear path 60 coinciding with the diameter of the wafer (col. 7, lines 31-38). Thus, the nozzles 31, 32, 33 in Shortes are specifically angled to deliver a single line of spray along the diameter of a wafer, not to deliver spray into hard-to-reach places on the wafer. Accordingly, there is no suggestion in Shortes to use angle spray nozzles in a box-cleaning apparatus, to spray hard-to-reach places on the wafer boxes, as claimed.

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In view of the foregoing, it is submitted that the claims are in condition for allowance, and a Notice of Allowance is requested.

Respectfully submitted,
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REPLACEMENT SPECIFICATION PARAGRAPHS

Please amend the paragraph beginning at pg. 1, line 5, as follows:

This Application is a Continuation-in-Part of U.S. Patent Application Serial No. 09/113,440, filed July 10, 1998, and now U.S. Patent No. 6,432,214.

Field of the Invention

The field of the invention is cleaning apparatus for cleaning carriers or containers used to hold and process semiconductor wafers, substrates, flat panel displays and similar flat articles or workpieces requiring low contamination levels.

Please amend the paragraph beginning at pg. 25, line 19, as follows:

Figs. 15-20 show operation of the box cleaner 400, as the rotor turns in direction A carrying a box 52. Cleaning fluid is supplied to all of the manifolds 402, 404, 406, 408, 410 and 412, such that liquid preferably simultaneously sprays out of all nozzles 430 and 432 on all of the manifolds. In Fig. 15, a straight spray from the straight spray nozzles 430 of the manifold 410 reaches and cleans certain side and back interior surfaces of the box 52. As the rotor moves the box 52 into the position shown in Fig. 16, the straight spray nozzles 430 on the manifold 402 preferably spray onto and into the box 52, with a similar pattern and geometry as the straight spray from manifold 410 in Fig. 15. However, the angle spray nozzles 432 on the manifold 402 spray at an angle θ , so that the trailing exterior side surfaces 452 and the leading interior corners 454 and interior side wall 456 are more directly sprayed and cleaned, as shown in Figs. 15 and 16.

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Please amend the paragraph beginning at pg. 26, line 12, as follows:

Turning to Fig. 17, when the box 52 rotates into the range of the manifold 404, the straight nozzles 430 on the manifold 404 spray into and onto the box in a way similar to the straight nozzles 430 on the manifolds 410 and 402. However, the angle spray nozzles 432 on the manifold 404 spray down at an angle, thereby better cleaning the up-facing surfaces 450 of the box 52, ~~as shown in Fig. 5.~~

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COMPLETE SET OF PENDING CLAIMS

1. (Original) A cleaning system for cleaning boxes used for moving and storing semiconductor wafers, comprising:

an enclosure;

a rotor rotatably supported within the enclosure, with the rotor having box positions for holding a box;

a plurality of spray manifolds positioned to spray a cleaning or rinsing fluid towards the rotor, with at least one of the spray manifolds having a plurality of straight spray nozzles, and also having at least one angle spray nozzle.

2. (Cancelled)

3. (Previously Presented) The cleaning system of claim 10 where the angle is from 30-60 degrees.

4-5. (Cancelled)

6. (Previously Presented) A method for cleaning five sided boxes used for carrying and storing semiconductor wafers, comprising the steps of:

placing the boxes in or on a rotor with an open side of the box facing radially outwardly and away from a center of the rotor;

spinning the rotor holding the boxes;

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spraying a first spray of a cleaning liquid towards the center or spin axis of the rotor; and

spraying a second spray of the cleaning liquid at an angle relative to the first spray.

7-8. (Cancelled)

9. (Previously Presented) The method of claim 6 where the center axis of the first spray is aimed at the center of the rotor, and the centerline of the second spray is aimed at an angle to the first spray, so that the second spray sprays a pattern of liquid in a direction towards or opposite to the spin direction of the rotor.

10. (Previously Presented) A cleaning system for cleaning boxes used for moving and storing semiconductor wafers, comprising:

an enclosure;

a rotor rotatably supported within the enclosure, with the rotor having box positions for holding a box;

a plurality of spray manifolds positioned to spray a cleaning or rinsing fluid towards the rotor, with at least one of the spray manifolds having a plurality of straight spray nozzles, and also having at least one angle spray nozzle, wherein the straight spray nozzles spray in a pattern having a horizontal central axis, and the angle spray nozzle sprays in a pattern having a central axis extending upwardly or downwardly at an angle relative to the horizontal central axis.

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11. (Previously Presented) A cleaning system for cleaning boxes used for moving and storing semiconductor wafers, comprising:

- an enclosure;
- a rotor rotatably supported within the enclosure, with the rotor having box positions for holding a box;
- a plurality of spray manifolds positioned to spray a cleaning or rinsing fluid towards the rotor, with at least one of the spray manifolds having a plurality of straight spray nozzles, and also having at least one angle spray nozzle, wherein the angle spray nozzle is oriented to spray in a pattern having a central axis directed opposite to the direction of rotation of the rotor.

12. (Previously Presented) A cleaning system for cleaning boxes used for moving and storing semiconductor wafers, comprising:

- an enclosure;
- a rotor rotatably supported within the enclosure, with the rotor having box positions for holding a box;
- a plurality of spray manifolds positioned to spray a cleaning or rinsing fluid towards the rotor, with at least one of the spray manifolds having a plurality of straight spray nozzles and two angle nozzles separated by at least two straight spray nozzles.

13. (Previously Presented) A method for cleaning five sided boxes used for carrying and storing semiconductor wafers, comprising the steps of:

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placing the boxes in or on a rotor with an open side of the box facing radially outwardly and away from a center of the rotor;

spinning the rotor holding the boxes;

spraying a first spray of a cleaning liquid towards the center or spin axis of the rotor; and

spraying a second spray of the cleaning liquid at an angle relative to the first spray;

where the first spray is sprayed in a pattern having a centerline or center axis which is horizontal, and where the second spray is also sprayed in a pattern having a centerline which is horizontal.

14. (Previously Presented) A method for cleaning five sided boxes used for carrying and storing semiconductor wafers, comprising the steps of:

placing the boxes in or on a rotor with an open side of the box facing radially outwardly and away from a center of the rotor;

spinning the rotor holding the boxes;

spraying a first spray of a cleaning liquid towards the center or spin axis of the rotor; and

spraying a second spray of the cleaning liquid at an angle relative to the first spray, with the first spray oriented horizontally and the second spray oriented upwardly or downwardly at an angle relative to the first spray.

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15. (Previously Presented) A cleaning system for cleaning boxes used for moving and storing semiconductor wafers, comprising:

an enclosure;

a rotor rotatably supported within the enclosure, with the rotor having box positions for holding a box;

a plurality of spray manifolds positioned to spray a cleaning or rinsing fluid towards the rotor, with at least one of the spray manifolds having one or more first spray nozzles, and also having one or more second spray nozzles, with the second spray nozzles at an angle of 10-80 degrees to the first spray nozzles.

16. (Previously Presented) A method for cleaning boxes used for carrying and storing semiconductor wafers, comprising the steps of:

placing the boxes in or on a rotor;

spinning the rotor holding the boxes;

spraying a first spray of a liquid from a first set of nozzles on a manifold in a first direction towards the boxes; and

spraying a second spray of the liquid from a second set of nozzles on the manifold in a second direction different from the first direction.

17-20. (Cancelled)

21. (Currently Amended) A cleaning system for cleaning boxes used for holding wafers, comprising:

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an enclosure;

a rotor within the enclosure for holding boxes radially about a spin axis of the rotor;

a plurality of spray manifolds positioned to spray fluid towards the rotor, wherein at least one of the spray manifolds includes one or more angle spray nozzles directed to spray fluid toward at least one of a leading interior side surface and a trailing interior side surface of a box on the rotor.

22. (Previously Presented) The cleaning system of claim 21 wherein the at least one spray manifold includes a plurality of angle spray nozzles, with each of the angle spray nozzles oriented at the same angle.

23. (Previously Presented) The cleaning system of claim 21 wherein the at least one spray manifold includes at least two angle spray nozzles oriented at different angles.

24. (Previously Presented) The cleaning system of claim 21 wherein the angle spray nozzle is oriented to spray fluid in a pattern having a central axis extending upwardly or downwardly relative to a horizontal axis.

25. (Previously Presented) The cleaning system of claim 21 wherein the angle spray nozzle is oriented to spray fluid in a pattern having a central axis directed opposite to a direction of rotation of the rotor.

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26. (Previously Presented) The cleaning system of claim 21 wherein at least one of the spray manifolds includes a straight spray nozzle.

27. (Previously Presented) The cleaning system of claim 21 wherein the at least one spray manifold has two or more straight spray nozzles between two angle spray nozzles.

28. (Currently Amended) A cleaning system for cleaning boxes used for holding wafers, comprising:

an enclosure;

a rotor within the enclosure, with the rotor having ~~a box position~~ a plurality of box holder assemblies for holding ~~[[a]] boxes~~; and

spray means for spraying a cleaning or rinsing fluid towards the rotor, with the spray means including an angle spray nozzle directed to spray fluid toward or away from a direction of rotation of the rotor.

29. (Cancelled)

30. (Currently Amended) A cleaning system for cleaning boxes used for holding wafers, comprising:

an enclosure;

a rotor within the enclosure, for holding boxes;

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a plurality of spray nozzles positioned to spray fluid towards the rotor, with at least one of the spray nozzles comprising an angle spray nozzle directed to spray fluid toward an up facing surface or a down facing surface of a box on the rotor.

31. (Cancelled)

32. (Currently Amended) The cleaning system of claim 30 wherein the ~~angle spray nozzle is oriented to spray fluid in a pattern having a central axis extending upwardly or downwardly relative to a horizontal axis.~~ boxes are held in the rotor at positions spaced apart from a spin axis of the rotor, so that the boxes revolve around the spin axis.

33. (Previously Presented) The cleaning system of claim 30 wherein the angle spray nozzle is oriented to spray fluid in a pattern having a central axis directed opposite to a direction of rotation of the rotor.

34. (New) A cleaning system for cleaning boxes used for holding wafers, comprising:
an enclosure;
a rotor within the enclosure, with the rotor having a box position for holding a box; and
spray means for spraying a cleaning or rinsing fluid towards the rotor, with the spray means including an angle spray nozzle and a straight spray nozzle.

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35. (New) A cleaning system for cleaning boxes used for holding wafers, comprising:

an enclosure;

a rotor within the enclosure, for holding boxes;

a plurality of spray nozzles positioned to spray fluid towards the rotor, with at least one of the spray nozzles comprising an angle spray nozzle, and at least one of the spray nozzles comprising a straight spray nozzle.

36. (New) A cleaning system for cleaning doors of boxes used for holding wafers, comprising:

a rotor including a plurality of box door holder assemblies for holding box doors;

a plurality of spray nozzles positioned to spray fluid towards the rotor, with at least one of the spray nozzles comprising an angle spray nozzle.

37. (New) A cleaning system for cleaning boxes used for holding wafers, comprising:

an enclosure;

a rotor within the enclosure, for holding boxes;

a plurality of spray nozzles positioned to spray fluid towards the rotor, with at least one of the spray nozzles comprising an angle spray nozzle directed to spray fluid toward at least one of an upper section and a lower section of the rotor.

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38. (New) The cleaning system of claim 37, wherein at least one of the spray nozzles comprises a second angle spray nozzle directed to spray fluid toward or away from a spin direction of the rotor.

39. (New) The cleaning system of claim 28 wherein the angle spray nozzle is directed to spray fluid toward an interior corner of a box held on the rotor.

40. (New) The cleaning system of claim 21 wherein at least one of the angle spray nozzles is directed to spray fluid toward the leading interior side surface of the box, and at least one of the angle spray nozzles is directed to spray fluid toward the trailing interior side surface of the box.

41. (New) A cleaning system for cleaning boxes used for holding wafers, comprising:

a rotor having a box position for holding a box; and

one or more first spray nozzles, and one or more second spray nozzles, for spraying a fluid towards the rotor, and with at least one of the first spray nozzles at an angle of 10-80 degrees to one of the second spray nozzles.